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Spectrally resolved OLR from IASI measurements

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The Earth's Outgoing Longwave Radiation (OLR) is a key component in the study of climate feedbacks and processes. As part of the Earth's radiation budget, it reflects how the Earth-atmosphere system compensates the incoming solar radiation at the top of the atmosphere. It can be retrieved from the radiance intensities measured by satellite sounders and integrated over all the zenith angles of observation. Since satellite instruments generally acquire the radiance at a limited number of viewing angle directions and because the radiance field is not isotropic, the conversion is however not straightforward. This problem is usually overcome by the use of empirical angular distribution models (ADMs) developed for different scene types that directly link the directional radiance measurement to the corresponding OLR.

OLR estimates from dedicated broadband instruments are available since the mid-1970s; however, such instruments only provide an integrated OLR estimate over a broad spectral range. They are therefore not well suited for tracking separately the impact of the different parameters affecting the OLR (including greenhouse gases), making it difficult to track down deficiencies in climate models. Currently, several hyperspectral instruments in space acquire radiances in the thermal infrared spectral range, and in principle, these should allow to better constrain the OLR. However, as these instruments were not specifically designed to measure the OLR, there are several challenges to overcome. Here we propose a new retrieval algorithm for the estimation of the spectrally resolved OLR from measurements made by the IASI sounder on board the Metop satellites. It is based on a set of spectrally resolved ADMs developed from synthetic spectra for a large selection of scene types associated with different states of the atmosphere and the surface. Atmospheric and surface parameters are derived from the Copernicus Atmosphere Monitoring Service (CAMS) reanalysis dataset and selected using a dissimilarity-based subset selection algorithm. These spectral ADMs are then used to convert the measured IASI radiances into spectral OLR.

We then evaluate how the IASI OLR compare with the CERES and the AIRS integrated and spectral OLR. We analyze the interannual variations in OLR over 10 years of IASI measurements for selected spectral channels using EOF analysis and we connect them with well-known climate phenomena such as El Niño-Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), the

Atlantic Multidecadal Oscillation (AMO).